Int.J.Curr.Microbiol.App.Sci (2025) *14*(01): 184-192

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 Volume 14 Number 1 (2025)
Journal homepage: http://www.ijcmas.com

Review Article https://doi.org/10.20546/ijcmas.2025.1401.015

Jast (Zinc) an Essential Inorganic Element for Biological Function and Human Health Studies: A Review

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Keywords

Zinc (*Jast*), Chemical compound, Biological function

Article Info

Received: 19 November 2024
Accepted: 21 December 2024
Available Online: 10 January 2025

A B S T R A C T

Jast (zinc) is a metallic essential element in human physiology, its atomic mas 65.38, atomic number 30, it's found in combined with oxygen as red oxide, with carbon as an impure carbonate, with Sulphur as Sulphide or Sulphuret or with Silica as Silicate zinc is important elements for life on earth are highly conserved among species. Zinc sites in proteins consist of Zn polyhedral with apical S, N, or 0, associated with cysteine, histamine, glutamic acid, aspartic acid, and water, more than 300 identified zinc enzymes. Zinc is prepared zinc finger protein, enzyme, and hormones. It is use in many diseases and biological function likes cough, fever, leucorrhoea, burn, diarrhoea, prevention of cancer and immunity, cardiovascular system central nervous system diabetes mellitus depression viral diseases coronavirus, human immunodeficiency virus. Zinc is most important inorganic element for biological function and health.

Introduction

The atomic number of *Jast* (zinc) is 30, and its stable isotopes have masses of 66, 67, 68, and 70, with an average of 65.38 atomic mass units. Zinc's terrestrial chemistry is that of zinc (II) rather than zinc (O). The Zn (II) ion has an electron configuration of *Is2, 2S2, 2p6, 3dl0,* and therefore lacks unfilled *d* subshells in the well-known oxidation state, the requisite criterion for true transition metals. Numerous zinc minerals-sulphides, sulphates, oxides, carbonates, phosphates, and silicates have been described, most containing tetrahedral or octahedral coordination polyhedral with either apical S or 0. Some minerals have both tetrahedral and octahedral coordinated zinc (II), while others have fivefold coordination polyhedral alternating structures, reflecting the whole and spherical 3d subshell. With octahedral coordinated zinc (II), which does not favour on coordination over another, The stabilities of aqueous zinc complexes have been measured for hydroxides, chloride, carbonate, sulphate, sulphide, phosphate, simple organic acids, amino acids, and synthetic chelates. Zn (II) coordination in aqueous formulations is typically octahedral, though it can also be four fold or five times.

Since zinc is needed as a structural element or reaction site in many proteins, which contain zinc-binding regions, zinc is important elements for life on earth are highly conserved among species. Zinc sites in proteins consist of Zn polyhedral with apical S, N, or 0, associated with cysteine, histamine, glutamic acid, aspartic acid, and water. When zinc is coupled with four groups of thiol that are generated from cysteine, the resulting coordination number is four. When zinc is associated with several reactive sites that have 0 and N as their apices, its coordination number is six (Barak and Helmeke, 1993).

The term "galvanization of biology" was coined due to the high frequency of genes encoding zinc proteins (more than 3% of the 32,000 genes found in the human genome). More than 300 identified zinc enzymes, such as carbonic anhydrase, alcohol dehydrogenase, carboxy peptidase, glutamic dehydrogenase, lactic dehydrogenase, and alkaline phosphatase, as well as hormones like prolactin, thymulin, testosterone, and somatomedin, are included in the category of zinc biomolecules. Among the largest groups of eukaryotic proteins is a zinc finger protein (Parisi and Valle, 1969; Zapsalis and Beck, 1985).

Sources

Jast is never occurs free in nature, but exists variously combined with elements to form salts. It exists combined with oxygen as red oxide, with carbon as an impure carbonate, with Sulphur as Sulphide or Sulphuret or with Silica as Silicate. Charcoal is used to sublimate zinc oxide to produce zinc (Nadkarni, 1982). The range of zinc content in humus is 1.00 to 1860 mg kg-1, with a median of 46.0 mg kg-1. The Zinc distribution low values in humus (<30 mg kg^{-1}) prevail over western France, Ireland, northern and south-west England and northern Scotland, the glacial drift area from Denmark over west central Norway, majority of Poland, southern Lithuania, and north eastern Germany. High Zn values (>63 mg kg-1) in humus usually occur in a region spanning from central Germany into the northwest of the Czech Republic, through Belgium and adjacent northern France, southern Poland and Slovakia, northern Italy and its surrounding Switzerland and Austria, central Sweden, northern Norway, and only a small part of eastern Finland. In humus, there is a solitary anomaly of Zn in southwest Norway. On the moss geochemistry map showing precipitation from the air, the same anomaly location is indicated (Ruhling and Stienres, 1998). Zinc occurs in India Rajasthan, Andhra Pradesh, Gujarat, Orissa and West Bengal (Qureshi *et al.,* 2013).

Vernacular Names

Arabic; Shibha, Kharseen, Bengali; Dasta, Can; Sattu, Chinese; Tutenague, Duck; Jas, English; Spelter, Zinc, Gujrat; Jasad, Hindi; Jasta, Konkan; Tambaku, Malayalam; Nagam, Tam, Tambaga-putch, Persian; Ruhe tutya, Sanskrit; Yashada, Tuttinaga, Tamil; Tutanagam, Telugu; Tuttunagam, Urdu; Jast (Ghani, 2011; Nadkarni, 1982; Qureshi *et al.,* 2013).

***Mizaj* (Temperament):** 2º/3º Garm Khusk (Hot and Dry) (Ghani, 2011)

Doses of Zinc

Unani medicine doses form of Zinc

4 Ratti (500mg), (Ghani, 2011), 50-125 mg (Anonymous, 1993), 2-6 grain (Nadkarni, 1982), 60mg (Qureshi *et al.,* 2013).

Medical dose: 40 mg/d of elemental zinc (Institute of Medicine, U.S., 2017) **Pharmacological doses:** 220 mg/d to 660 mg/d of chelated zinc, (Wang *et al.,* 2017; Ranasinghe *et al.,* 2015).

Approximately doses: 50 mg to 150 mg of elemental zinc (Wang *et al.,* 2017; Ranasinghe *et al.,* 2015).

Children (RDA) recommended daily allowance of 3 mg daily for 7 to 12 months, 3 mg daily for 1 to 3 years, 5 mg daily for 4 to 8 years, and 8 mg daily for 9 to 13 years, Infants (AI) 0 to 6 months: 2 mg per day (mg/day), 7 to 12 months: 3 mg per day. How Much to Take in Supplements: 5–20 mg per day (Solomons, 2013). For infants under six months old: 10 mg (one-half pill) once daily for ten to fourteen days, for kid's ages 6 to 5, take 20 mg (1 tablet) once daily for 10–14 days (WHO, 2005, 2006).

Adolescents and Adults (RDA) suggested daily allowance Men over the age of 14 year: 11 mg daily, 14–18-year-old females: 9 mg daily, Women aged 19 and up: 8 mg daily, Women who are pregnant and those who are 19 years of age or older: 11 mg daily, Women who are nursing and those who are 19 years of age or older: 12 mg daily (Rovinovich, 2023).

Over dose Symptoms of zinc

Zinc overdose results in emesis. Furthermore, excessive amounts of zinc sulphate can induce gastrointestinal tract irritation and corrosion, including stomach ulcers and even perforation. Interstitial nephritis and acute renal tubular necrosis have also been linked to excessive zinc dose. Copper insufficiency can arise from long-term high dose zinc supplementation (WHO, 2005, 2006).

Important Unani formulation

Kushta Jast (Anonymous, 1993; Ghani, 2011; Qureshi *et al.,* 2013)

***Af'al* (Actions) in Unani classical literature:** (Nadkarni, 1982; Ghani, 2011; Anonymous, 1993)

Amraz-e-Baul (Urinary disorders), *Amraz-e-Chasm* (eye diseases), *Daf-e- Ziyabetees* (Antidiabetic) *Daf-e-Afunat (Antiseptic***),** *Faqrud dam* (Aneamia), *Zeequnnafs* (Asthma) Prostate disorder, Nervine tonic, Sedative, Antisposmodic, Astringent, (Nadkarni, 1982), *Mohallil* (Resolvent), *Muqawwi* (Tonic), *Muqawwi -e-Maida* (Gastric tonic), *Muqawwi-e-Baah* (Aphrodiasic), *Muqawwi-e-Qalb* (Cardio Tonic), *Qabiz* (Desicative), *Musakkin* (Sedative), *Mujaffi-e-Khoon* (Blood purifier), *Mumsik* (Avaricious), *Qabiz* (Desicative), *Daf-e-Hmma* (Antipyretic),

Therapeutic Uses in Unani classical Literature: (Nadkarni, 1982; Ghani, 2011; Anonymous, 1993; Qureshi *et al.,* 2013)

Dama (Asthama), *Sual* (Cough), *Sil-wa-Diq* (Tuberculosis), *Humma* (Fever), *Rasha* (Tremor), *Jiryan* (Spermatorrhoea), *Surat-e-Enjal (*Premature ejaculation*), Sarayet-e- Ehtalam, Sailan –ur- Reham* (Leucorrhoea), *Nar farsi* (Eczema), *Naffatat Tafliyya* (Impetigo), excoriation, *Qarha Qatat* (Bed-Sores), *Jarah* (Wounds), *Haraq* (Burns), *Sara* (Epilepsy), *Haiza* (Cholera), *Shaheeqa* (Whooping cough), *Ikhtenaq-ur-Reham* (Hysteria), *Suzak* (Gonorrhoea), *Sailan-e-Mani* (Spermatorrhoea), *Zof-e-Umumi* (General debility) *Ishal* (Diarrhoea), Cracked nipples, Dipsomania, Bronchorrhea,

Chemical Compounds of *Jast* (Zinc)

Zinc acetate ($Zn(C_2H_3O2)\ 2H_2O$), Zinc ammonium chloride ($ZnCl_2\ 2NH_4Cl$), Zinc diborate ($ZnO\ B_2O_3\ 2H_2O$), Zinc dodecaborate ($2ZnO\ 3B_2O_35H_2O$), Zinc bromide ($ZnBr_2$), Zinc carbonates ($ZnCO_3$), Zinc chloride ($ZnCl_2$), Zinc cyanide ($Zn\ (CN)_2$, Zinc dibutyl ($Zn\ SCN\ (C_2H_2)_2$, Zinc diethyl ($Zn\ SCN\ (C_2H_2)_2$, Zinc ethylenebis ($Zn\ SCNHCH_2$), Zinc 2-ethylhexanoat ($Zn\ (C8H_{16}O_2)_2$, Zinc fluoroborate ($Zn\ (BF_4)_2\ 6H_2O$), Zinc fluoride (ZnF_2), Zinc formaldehyde sulfoxylate ($Zn\ (HSO_2\ CH_2O)\ _2$), Zinc hydrosulfite ($ZnS_2O_4\ 2H_2O$), Zinc iodide (ZnI_2), Zinc 2-mercaptobenzothiazole ($Zn\ (SC_6H_4NCS)\ _2$, Zinc naphthenate ($Zn\ [(C_2H)\ 5CHCOO]\ _2$), Zinc nitrate ($Zn\ (NO_3)_2\ 6H_2O$), Zinc oxide (ZnO), Zinc peroxide (ZnO_2), Zinc phosphate ($Zn_3\ (PO_4)_2$), Zinc potassium chromate ($4ZnO\ K_2O\ 4CrO_3\ 3H_2O$), Zinc resinate ($Zn\ (C_20H_3O\ O_2)_2$), Zinc selenide ($Zn\ Se$), Zinc nitrate ($Zn\ (NO_3)_2\ 6H_2O$), Zinc silicofluoride ($ZnSiF_6\ 6H_2O$), Zinc stearate ($Zn\ (C_{17}H_{53}COO)\ _2$), Zinc sulfate ($ZnSO4$), Zinc sulfate ($ZnSO_4\ H_2O$), Zinc sulfide ($ZnS$), Zinc tetroxychromate ($4Zn\ (OH)\ _2\ ZnCrO_4$), Zinc undecylenate ($Zn\ (CH_2CH\ (CH2)_8\ COO)_2$ (Goodwin, 2017).

Biological Function of *Jast* (Zinc)

Function of Zinc an Antimicrobial

Zinc chloride, zinc citrate, zinc sulphate, and zinc gluconate were evaluated for their antimicrobial activity against *Salmonella typhi*, *Streptococcus aureus*, *Candida albicans*, and *Staphylococcus aureus* (Muniza, 1998). The surface of zinc oxide nanoparticles (ZnO NPs) releases highly reactive oxygen species (ROS), which harm bacteria.

ROS may cause the bacteria's cell wall and membrane to degrade, allowing cell contents to leak out and ultimately killing the organism. Several gram-positive (*Bacillus coagulans*, *Staphylococcus aureus*, *Bacillus subtilis*) and gram-negative (*Shigella dysenteriae*, *Sphingomonas* *paucimobilis*, *Salmonella typhi*murium, *Escherichia coli*, *Bacillus pumilus*, and *Salmonella typhi*) bacteria have been shown to be susceptible to the antibacterial action of ZnO NPs made from plant extracts. Freed from ZnO NPs, zinc ions (Zn2+) may target the cell's proteins and DNA, preventing the bacterium from growing. Certain bacteria (including *S. typhi* and *E. coli*) have negative charges on their surfaces that interact with positively charged particles in ZnO NPs to prevent their growth.

The size, content, and type of surfactant utilized in the production of zinc oxide nanoparticles all affect how quickly they exhibit antibiotic activity. Because of their antibiotic properties, ZnO NPs can be used as an antibacterial coating for plastic food containers, linings for food cans used for food packaging and preservation, and the inner surfaces of refrigerators and dishwashers to prevent food from deteriorating (Kavitha *et al.,* 2022).

Function of Zinc an Anti-oxidant

Peel extract from *Luffa acutangula* is a useful tool for creating nanoscale ZnO nanoparticles; SEM examination was performed to clarify the form of the generated ZnO nanoparticles. FTIR spectral investigation verified the existence of Zn-O bonding as well as additional bondings such C-O and O-H. DPPH analysis demonstrated that the biosynthesized ZnO nanoparticles possessed antioxidant properties (Ananthalkshmi, 2019).

Function of Zinc in Wound Healing

Delayed wound healing has been associated with zinc deficiency (Keenan and Moris, 1993; Andrew and Gallagher Allred, 1999). Additionally, it is essential for the repair of stomach ulcers, particularly in the early stages (Wantabe *et al.,* 1995).

Function of Zinc in Reproduction

Zinc levels were much greater in males with normal testosterone levels than in individuals with low testosterone levels, according to a study including 88 men between the ages of 40 and 60. Male menopause symptoms were more likely to occur in these guys because low testosterone levels were strongly connected with low zinc levels (Banu Devi *et al.,* 2011; Chang *et al.,* 2011).

Zinc helps in the development of the oocyte, or egg, in females. A zinc shortage in women results in immature eggs, which delay ovulation and ultimately result in infertility. Sufficient zinc levels enable women to utilize progesterone and oestrogen effectively, promoting fertility and guaranteeing that oestrogen performs as intended in the body. Inadequate metabolism or excessive oestrogen production can lead to breast cancer and problems with reproduction (Piechal *et al.,* 2012).

Function of Zinc in Cardiovascular System

Maintaining the health of endothelium and cardiovascular cells involves zinc. The endothelium is the thin layer of cells that surrounds blood arteries and is essential during circulation. An endothelial barrier deficit brought on by low zinc levels increases the risk of inflammation and the build-up of elevated cholesterol. Cardiovascular disease risk is increased by cholesterol and inflammation. Research indicates that low zinc levels might exacerbate the adverse effects of a high-fat, high-cholesterol diet on the cardiovascular system, while sufficient zinc intake may prevent the development of heart disease. The accumulation of inflammatory markers, such as C-reactive proteins and cytokines—dubbed "slow, silent killers"—is particularly dangerous for the older population (Yari, 2011; Myolor, 2006).

Function of Zinc in Central Nervous System

Zinc is needed for neurotransmitter function and for managing the health and structure of the nervous system. It is required for melatonin metabolism, which controls dopamine. Additionally, zinc is a component of an enzyme that the brain membrane's anabolism of fatty acids depends on. This is critical because maintaining the health and function of the brain requires that the membrane receive the nutrients it requires. When treating ADHD, zinc is a mineral that is often overlooked. According to research, babies with ADHD usually have lower zinc levels than babies without ADHD. More encouragingly, a study involving 400 kids with ADHD diagnoses reported that consuming 150 mg/d of zinc sulphate reduced respondents' hyperactivity and impulsivity and improved their impaired social behaviour compared to a placebo. The sociability and hyperactivity scores improved more dramatically in those with a greater body mass index and lower levels of fatty acids when they took zinc (Yari, 2011).

In a rat study, the effects of supplementing pregnant females with zinc during breastfeeding and gestation were examined. The results showed improved spatial memory and general cognitive development in the offspring. Best results were obtained with a substantial dose of zinc. The effectiveness of zinc in treating attention deficit hyperactivity disorder (ADHD) has been demonstrated by evidence from limited human research' (Piechal, *et al.,* 2012; Yari, 2011).

Function of Zinc in Diabetes mellitus

Ortega, Rodriguez, and others, the majority of hormones, including insulin, require zinc to operate properly. At least three functions of enough zinc are related to the health of insulin. Insulin is effectively stored in the pancreas and released when glucose enters the bloodstream thanks to zinc's binding to the hormone. Because zinc is a part of the enzymes that insulin needs to bind to cells in order for glucose to enter and be used as fuel, zinc enhances the health of cells.

The concept of "insulin sensitivity" defines the method by which insulin binds to a cell, showing that the cell is responsive to the hormone. Insulin "opens the door" for glucose to enter a cell after it attaches to it. Glycogen may remain in the bloodstream, result in elevated blood sugar, and eventually cause fat growth if the cell is resistant to insulin.

Reduced insulin secretion and peripheral insulin sensitivity result from falling zinc concentrations, and if these effects are sustained, diabetes results. Thanks to its ability to eliminate inflammatory indicators like C-reactive proteins, zinc possesses anti-inflammatory properties. In addition to maintaining cell health and insulin sensitivity, zinc aids in the removal of chemicals that irritate cells (Ortega *et al.,* 2012).

Function of Zinc in Depression

In the 2005 study by Nowak *et al.,* (2005) examined the effects of zinc in an appropriate mouse model. Zinc has been shown to exhibit antidepressant properties. Like antidepressants, zinc raises the amount of synaptic pool of zinc in the hippocampus and stimulates the production of the gene for brain-derived neurotropic factor (Nowak, *et al.,* 2005). It's suggested that female students who suffer from depression should eat a diet high in zinc (Amani *et al.,* 2010). Patients with thalassemia had their hair samples examined for zinc levels. Depression cases have been connected to these patients' inherent vulnerability to zinc deficiency.

Function of Zinc in Prevention of Cancer and Immunity

Since zinc is present in every bodily tissue and plays a direct role in cell division, it is extremely significant. Zinc is a potent antioxidant that can help prevent cancer, but it also has a direct role in maintaining healthy hormone levels and proper endocrine function (Maseregian *et al.,* 2011). The immune system is significantly impacted by zinc deficiency because low zinc directly and quickly reduces T cell activity. T lymphocytes strengthen the immune system of the body in response to infections, pathogens, or health hazards. Zinc deficiency is more common in older adults and is not exclusively associated with inadequate food intake. Research suggests that as we age, our body may require more zinc to maintain immune system function, reduce inflammation, and promote healthy cell growth (Wong and Ho, 2012).

Function of Zinc in the Immune System

Since both enhanced and reduced zinc levels result in compromised immune function, zinc effectively regulates immune activity (Chandra, 1990; Rink and Gabril *et al.,* 2001) when immunodeficiency and zinc deficiency interact, the susceptibility too many infections is increased (Shankar and Prasad, 1998), It has also been demonstrated in rat sympathetic neurons (Clouse *et al.,* 1993). Deficits in iron and zinc affect T- and B-lymphocyte activity through protein kinase C-dependent systems (Klecha *et al.,* 2005).

Function of Zinc in Coronaviruses Disease

Potential zinc protective effects are especially interesting in light of the global COVID-19 epidemic. Because zinc directly inhibits viruses and has an immune-modulating impact, it is thought to be a viable supportive treatment for COVID-19 infection (Zhang *et al.,* 2020). A zinc-related method to regulate COVID-19 control might involve looking at the structure of viral proteins which include zinc ions. In particular, it has been shown that Zn2+ release from papain-like protease in MERS CoV and SARS CoV is stimulated by disulfiram, leading to protein instability (Lin *et al.,* 2018). It was demonstrated that Zn2+ cations, particularly when combined with the Zn ionophore pyrithione, inhibited the replication of the SARS coronavirus RNA polymerase (RNA dependent RNA polymerase, or RdRp) (te Velthuis, 2010).

Figure.1

Function of Zinc in HIV

Since zinc lack prevents T lymphocyte development and certain functions like activation, Th1 cytokine synthesis, and B-lymphocyte support, it affects the development of acquired immunity. (Shankar and Prasad, 1998), Zn also prevents the synthesis of TNF (tumour necrosis factor), which is connected to the mechanism of wasting and cachexia in acquired immune deficiency syndrome (Baum *et al.,* 2000).

Function of Zinc in Diarrhoea

The WHO Task Force (2001) and the National Task Force of the Indian Academy of Paediatrics (IAP) have recommended zinc as a therapy for diarrhea (Bhatnagar and Natchu, 2004).

Additionally, when used as a diarrhoea treatment, it raises serum zinc concentration and aids in children's maintenance of a more appropriate zinc status throughout the melancholic phase (Baqui *et al.,* 2006). One possible explanation for the reported effect of zinc supplementation on diarrheal morbidity is that it enhances cellular immune state (Sazawal *et al.,* 1997).

Jast (Zinc) is a metallic element with atomic number 30, average atomic mas 65.38 and d-Transition element. Zinc is most important essential inorganic element for biological function and health. Encoding zinc proteins more than 3% of 32,000 genes in the human genome, and more than 300 identified zinc enzymes. Function of Zinc in reproduction, Prevention of cancer and immunity, immune system, cardiovascular system, central nervous system, diabetes mellitus, depression, Coronaviruses disease, human immunodeficiency virus (HIV), diarrhoea, wound healing, antimicrobial, anti-oxidant.

Over doses of zinc cause emesis, irritation, corrosion of the gastrointestinal tract, ulceration of the stomach and possible perforation, acute renal tubular necrosis and interstitial nephritis, prolonged high dose zinc supplementation may result in copper deficiency.

Acknowledgement

The authors would like to express their thanks to Prof. (Dr) Mohammad Idrees, Department of *Ilmul Saidla* (Pharmaceutical science), A & U Tibbia College Karol Bagh New Delhi, and Dr. Najmus Sehar, Deputy Director, CRIUM, Lucknow for providing all the essential assistant and motivation to work,

Author’s Contributions

Dr. Mohd Tauseef Alam, Dr. Mohd Saleem, participated in article writing and other authors participated in article reading and proofing.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Funding source: None

Ethical Approval Not applicable.

Consent to Participate Not applicable.

Consent to Publish Not applicable.

Conflict of Interest The authors declare no competing interests.

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How to cite this article:

Raghubanshi, Mohd Saleem, Mohd Tauseef Alam, Arifa Khatoon, Mohammad Idrees and Najmus Sehar. 2025. *Jast* (Zinc) an Essential Inorganic Element for Biological Function and Human Health Studies: A Review. *Int.J.Curr.Microbiol.App.Sci.* 14(01): 184-192. **doi:** https://doi.org/10.20546/ijcmas.2025.1401.015